REMARKS

The Office Action dated June 8, 2004, has been received and carefully noted. The following remarks are submitted as a full and complete response thereto.

Claims 1-5, 7-9, 12 and 13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Sato et al. (US Patent No. 5,861,601, hereinafter "Sato") in view of Otsubo et al. (US Patent No. 4,985,109, hereinafter "Otsubo"). Claims 3, 5, 6, and 9 depend from claim 1, claim 4 depends from claim 2, and claims 12-14 depend from claim 7. The Applicants respectfully submit that each of claims 1-5, 7-9, 12 and 13 recites subject matter that is neither disclosed nor suggested by the cited prior art.

Claim 1 recites a plasma processing apparatus for processing an object using a plasma. The apparatus includes a processing chamber defining a processing cavity for containing an object to be processed and a process gas therein, a microwave radiating antenna having a microwave radiating surface for radiating a microwave in order to excite a plasma in the processing cavity, and a dielectric body provided so as to be opposed to the microwave radiating surface. A distance D between the microwave radiating surface and a surface of the dielectric body facing away from the microwave radiating surface, which is represented with a wavelength of the microwave being a distance unit, is determined to be in a range satisfying an inequality $0.7 \times n/4 \leq D \leq 1.3 \times n/4$ (n being a natural number). Also, a standing wave of the microwave is formed between the microwave radiating surface and a plasma exciting surface, thereby exciting a plasma at the plasma exciting surface by being supplied with energy from the standing wave of the microwave, the plasma exciting surface substantially coinciding

with the surface of the dielectric body facing away from the microwave radiating surface, the plasma being formed between the plasma exciting surface and the object to be processed, the standing wave not entering the plasma.

Claim 2 recites a plasma processing apparatus for processing an object using a plasma. The apparatus includes a process chamber defining a processing cavity for containing an object to be processed and a process gas therein; a microwave radiating antenna having a microwave radiating surface for radiating a microwave in order to excite a plasma in the processing cavity; and a dielectric body provided so as to be opposed to the microwave radiating surface. A distance D between the microwave radiating surface and a surface of the dielectric body facing away from the microwave radiating surface, which is represented with a wavelength of the microwave being a distance unit, is determined to be in a range satisfying an inequality $0.7 \times n/2 \leq D \leq 1.3 \times n/2$ (n being a natural number). Also, a standing wave of the microwave is formed between the microwave radiating surface and a plasma exciting surface, thereby exciting a plasma at the plasma exciting surface by being supplied with energy from the standing wave of the microwave, the plasma exciting surface substantially coinciding with the surface of the dielectric body facing away from the microwave radiating surface, the plasma being formed between the plasma exciting surface and the object to be processed, the standing wave not entering the plasma.

Claim 7 recites a plasma processing method for processing an object using a plasma. The method includes the steps of putting an object to be processed and a process gas into a processing cavity defined in a processing chamber, radiating a

microwave for exciting a plasma from a microwave radiating antenna having a microwave radiating surface to the processing cavity, providing a dielectric body so as to be opposed to the microwave radiating surface, and determining a distance D between the microwave radiating surface and a surface of the dielectric body facing away from the microwave radiating surface, which is represented with a wavelength of the microwave being a distance unit, to be in a range satisfying an inequality $0.7 \times n/4 \leq D \leq 1.3 \times n/4$ (n being a natural number). Also a standing wave of the microwave is formed between the microwave radiating surface and a plasma exciting surface, thereby exciting a plasma at the plasma exciting surface by being supplied with energy from the standing wave of the microwave, the plasma exciting surface substantially coinciding with the surface of the dielectric body facing away from the microwave radiating surface, the plasma being formed between the plasma exciting surface and the object to be processed, the standing wave not entering the plasma.

Claim 8 recites a plasma processing method for processing an object using a plasma. The method includes the steps of putting an object to be processed and a process gas into a processing cavity defined in a processing chamber; radiating a microwave for exciting a plasma from a microwave radiating antenna having a microwave radiating surface to the processing cavity; providing a dielectric body so as to be opposed to the microwave radiating surface; and determining a distance D between the microwave radiating surface and a surface of the dielectric body facing away from the microwave radiating surface, which is represented with a wavelength of the microwave being a distance unit, to be in a range satisfying an inequality $0.7 \times n/2$

≤D ≤1.3 x n/2 (n being a natural number). Also a standing wave of the microwave is formed between the microwave radiating surface and a plasma exciting surface, thereby exciting a plasma at the plasma exciting surface by being supplied with energy from the standing wave of the microwave, the plasma exciting surface substantially coinciding with the surface of the dielectric body facing away from the microwave radiating surface, the plasma being formed between the plasma exciting surface and the object to be processed, the standing wave not entering the plasma.

Accordingly, at least one of the essential features of the present invention is a standing wave of the microwave that is formed between the microwave radiating surface and a plasma exciting surface, thereby exciting a plasma at the plasma exciting surface by being supplied with energy from the standing wave of the microwave, the plasma exciting surface substantially coinciding with the surface of the dielectric body facing away from the microwave radiating surface, the plasma being formed between the plasma exciting surface and the object to be processed, the standing wave not entering the plasma. As such, the present invention results in the advantage of having a plasma processing apparatus capable of generating a high density plasma.

It is respectfully submitted that the prior art fails to disclose or suggest the elements of the Applicants' invention as set forth in claims 1-5, 7-9, 12 and 13, and therefore fails to provide the advantages that are provided by the present application.

Claims 1, 2, 7, and 8 recite at least the feature of "the plasma being formed between the plasma exciting surface and the object to be processed, the standing wave not entering the plasma." The Office Action acknowledged that Sato fails to disclose

this feature of the invention. The Office Action cited Otsubo for curing this deficiency. As discussed below, Otsubo fails to cure this deficiency in Sato.

The Office Action took the position that Otsubo teaches "identical means . . . to delimit propagation of Otsubo's standing waves as taught by Applicants' specification." See page 3 lines 16-18 of the Office Action. However, delimiting propagation of standing waves is not comparable to "the standing wave not entering the plasma" as recited in claims 1, 2, 7, and 8. As such, there is no disclosure or suggestion in Otsubo of a standing wave not entering the plasma. Further, although the Office Action cited column 7 lines 3-15 for teaching this feature, this section merely states "[O]on the other hand, after the plasma generation, the slot locking arrangement is operated and the slot at the center is locked or closed, whereby microwaves are radiated from only the slot at the periphery." This statement does not provide for "the standing wave not entering the plasma", because microwaves are still radiated from the slot at the periphery allowing the standing wave to enter the plasma. Accordingly, the teachings of Otsubo are opposite from the teachings of the present invention. Therefore, Otsubo fails to cure the deficiencies in Sato, and the combination of Otsubo and Sato fails to disclose or suggest the features of the invention as recited in claims 1, 2, 7, and 8.

For at least the above reasons, the Applicants submit that neither Sato nor Otsubo, taken together or in combination, disclose or suggest each and every element recited in claims 1, 2, 7 and 8 of the present application. As for claims 3-5, 9, 12 and 13, it is submitted that each of these claims is dependent on independent claims 1, 2

and 7, respectively. As such, each of claims 3-5, 9, 12 and 13 is allowable due to its dependency on allowable claims 1, 2 and 7.

Claim 6 was rejected under 35 U.S.C. §103(a) as being unpatentable over Sato in view of Tsuchihashi et al. (US Patent No. 6,109,208, hereinafter "Tsuchihashi"). Additionally, claim 14 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Sato in view of Otsubo, and further in view of Tsuchihashi. The Applicants respectfully submit that each of claims 6 and 14 recites subject matter that is neither disclosed nor suggested by the cited prior art.

Each of claims 6 and 14 is dependent on independent claims 1 and 7, respectively. As such, each of claims 6 and 14 is allowable due to its dependency on allowable claims 1 and 7.

Claims 16-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Sato in view of Otsubo. Claims 18 and 20-22 depend from claim 16, claim 19 depends from claim 17 and claims 25 and 26 depend from claim 23. The Applicants respectfully submit that each of claims 16-26 recites subject matter that is neither disclosed nor suggested by the cited prior art. In particular, it is submitted that neither Sato nor Otsubo disclose or suggest the claimed features of the invention.

Claim 16 recites a plasma processing apparatus for processing an object using a plasma. The apparatus includes a processing chamber defining a processing cavity for containing an object to be processed and a process gas therein. A microwave radiating antenna having a microwave radiating surface for radiating a microwave in order to excite a plasma in the processing cavity, the microwave radiating antenna

being a radial line slot antenna having a number of slots formed and distributed in the microwave radiating surface; and a dielectric body provided so as to be opposed to the microwave radiating surface. A distance D between the microwave radiating surface and a surface of the dielectric body facing away from the microwave radiating surface, which is represented with a wavelength of the microwave being a distance unit, is determined to be in a range satisfying an inequality $0.7 \times n/4 \leq D \leq 1.3 \times n/4$ (n being a natural number).

Claim 17 recites a plasma processing apparatus for processing an object using a plasma. The apparatus includes a processing chamber defining a processing cavity for containing an object to be processed and a process gas therein; a microwave radiating antenna having a microwave radiating surface for radiating a microwave in order to excite a plasma in the processing cavity, the microwave radiating antenna being a radial line slot antenna having a number of slots formed and distributed in the microwave radiating surface; a dielectric body provided so as to be opposed to the microwave radiating surface. A distance D between the microwave radiating surface and a surface of the dielectric body facing away from the microwave radiating surface, which is represented with a wavelength of the microwave being a distance unit, is determined to be in a range satisfying an inequality $0.7 \times n/2 \leq D \leq 1.3 \times n/2$ (n being a natural number).

Claim 23 recites a plasma processing method for processing an object using a plasma. The method comprising the steps of putting an object to be processed and a process gas into a processing cavity defined in a processing chamber; radiating a

microwave for exciting a plasma from a microwave radiating antenna having a microwave radiating surface to the processing cavity, the microwave radiating antenna being a radial line slot antenna having a number of slots formed and distributed in the microwave radiating surface; providing a dielectric body so as to be opposed to the microwave radiating surface; and determining a distance D between the microwave radiating surface and a surface of the dielectric body facing away from the microwave radiating surface, which is represented with a wavelength of the microwave being a distance unit, to be in a range satisfying an inequality $0.7 \times n/4 \leq D \leq 1.3 \times n/4$ (n being a natural number).

Claim 24 recites a plasma processing method for processing an object using a plasma. The method includes putting an object to be processed and a process gas into a processing cavity defined in a processing chamber; radiating a microwave for exciting a plasma from a microwave radiating antenna having a microwave radiating surface to the processing cavity, the microwave radiating antenna being a radial line slot antenna having a number of slots formed and distributed in the microwave radiating surface; providing a dielectric body so as to be opposed to the microwave radiating surface; and determining a distance D between the microwave radiating surface and a surface of the dielectric body facing away from the microwave radiating surface, which is represented with a wavelength of the microwave being a distance unit, to be in a range satisfying an inequality $0.7 \times n/2 \leq D \leq 1.3 \times n/2$ (n being a natural number).

As a preliminary matter regarding the rejection, the Applicants note that the Office Action rejected claims 16-26 citing Otsubo for teaching forming a standing wave.

However, the Applicants respectfully point out that claims 16-26 do not recite forming a standing wave, and therefore request withdrawal of the rejection for failure to properly address the claimed features of the claimed invention.

In addition, the Applicants respectfully submit that the combination of Sato and Otsugo fails to disclose or suggest the features of the invention as recited in at least claims 16, 17, 23 and 24. In particular, it is submitted that the cited prior art fails to disclose or suggest at least the features of "a microwave radiating antenna having a microwave radiating surface for radiating a microwave in order to excite a plasma in the processing cavity, the microwave radiating antenna being a radial line slot antenna having a number of slots formed and distributed in the microwave radiating surface," and "radiating a microwave for exciting a plasma from a microwave radiating antenna having a microwave radiating surface to the processing cavity, the microwave radiating antenna being a radial line slot antenna having a number of slots formed and distributed in the microwave radiating surface; providing a dielectric body so as to be opposed to the microwave radiating surface."

The present invention provides at least a radial line slot antenna in combination with the distance D between the microwave radiating surface of the antenna and a surface of a dielectric body. Radial line slot antenna of the present invention have a number of line-shaped slots formed and distributed on a conductor surface as arranged in a spiral pattern or a concentric pattern. In contrast, Otsubo's antenna has arc-shaped slots, but does not have slots in the form of straight lines.

By using a radial line slot antenna of the present invention, strong plasma is generated just beneath the dielectric body, where microwaves are reflected. Therefore, by determining the distance between the antenna and a lower surface of the dielectric body based on the wavelength of the microwave, standing wage of microwave can be formed between the antenna and a lower surface of the dielectric body. Accordingly, the standing wave of the present invention does not enter the plasma formed between the lower surface of the dielectric body and the object to be processed. Thus, Applicants submit that the cited prior art fails to disclose or suggest each and every element recited in claims 16, 17, 23 and 24, and therefore is allowable.

As for claims 18-22, 25 and 26, it is submitted that each of these claims is dependent on independent claims 16, 17 and 23, respectively. As such, each of claims 18-22, 25 and 26 is allowable due to its dependency on allowable claims 16, 17 and 23.

Under U.S. patent practice, the PTO has the burden under §103 to establish a *prima facie* case of obviousness. In re Fine, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). Both the case law of the Federal Circuit and the PTO itself have made clear that where a modification must be made to the prior art to reject or invalidate a claim under §103, there must be a showing of proper motivation to do so. The mere fact that a prior art reference could arguably be modified to meet the claim is insufficient to establish obviousness. The PTO can satisfy this burden only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references. Id. In order to establish obviousness, there must be a suggestion or motivation in the

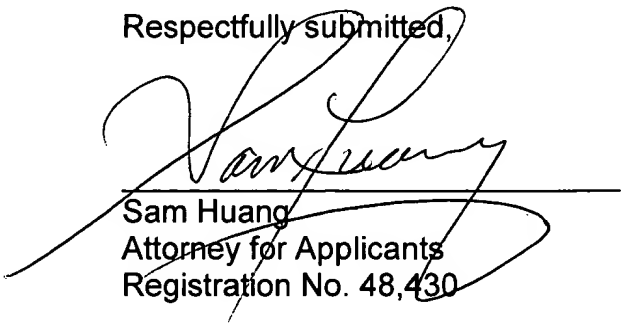
reference to do so. See also In re Gordon, 221 USPQ 1125, 1127 (Fed. Cir. 1984) (prior art could not be turned upside down without motivation to do so); In re Rouffet, 149 F.3d 1350 (Fed. Cir. 1998); In re Dembiczak, 175 F.3d 994 (Fed. Cir. 1999); In re Lee, 277 F.3d 1338 (Fed. Cir. 2002). The Office Action restates the advantages of the present invention to justify the combination of references. There is, however, nothing in the applied references to evidence the desirability of these advantages in the disclosed structure.

In view of the above, the Applicants respectfully submit that each of claims 1-9, 12-14 and 16-26 recites subject matter that is neither disclosed nor suggested in the cited prior art. The Applicants also submit that the subject matter is more than sufficient to render the claims non-obvious to a person of ordinary skill in the art, and therefore respectfully request that claims 1-9, 12-14 and 16-26 be found allowable and that this application be passed to issue.

If for any reason, the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact the Applicants' undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper has not been timely filed, the Applicants respectfully petition for an appropriate extension of time. Any fees for such an extension, together with any additional fees that may be due with respect to this paper, may be charged to counsel's Deposit Account No. 01-2300.

Respectfully submitted,



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